COLLECTING AND PRESERVING PSOCOPTERA (PSOCIDS, BOOKLICE, BARKLICE)

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Appearance

Psocids, also known as Barklice or Booklice (order Psocoptera) are small insects, from less than a millimetre to 10 millimetres in length. They are usually recognised in the field by their characteristic appearance (Fig. 1) which is due to the rounded, mobile head, enlarged thorax and the wings, which are held roof-wise over the abdomen. The antennae are long and fine, composed of many segments, with thirteen being the most usual number. There are few brightly coloured species; most are yellowish, brownish, grey or black in general appearance. On close examination, however, many have distinct body markings and in some species striking and complex wing patterns are found.

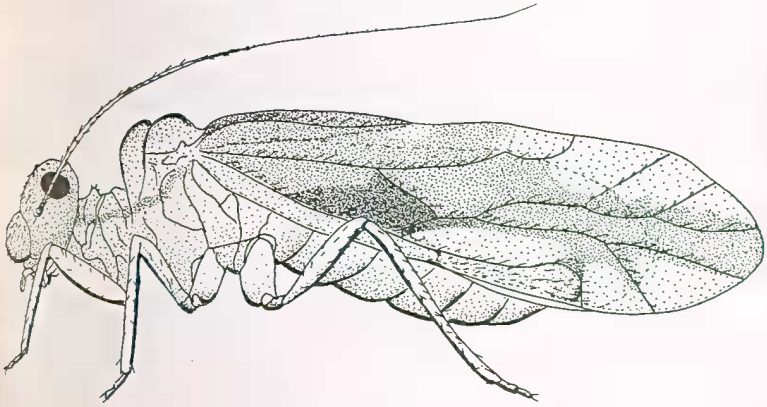


Fig. 1. A typical Psocopteran.

Although most species are winged in the adult stage there are many in which one or both sexes have shortened wings or are wingless. Psocids are generally somewhat sluggish and do not readily fly but under certain circumstances, usually at dusk in calm, warm weather large numbers of some species take flight. Nymphs (immature stages) of all species are wingless although wingbuds are evident on the thorax from the second instar; otherwise, they are similar to adults in appearance.

Habitat

They are found in a wide variety of situations such as on leaves (fresh or dead), on or under bark, on trunks or twigs, in leaf litter, on rocks, on paling fences, under stones, in caves, in human habitations and in stored products, especially cereals. The common name "book louse" is due to the fact that the

small, wingless members of one common genus are most often noticed amongst undisturbed books or papers and in neglected insect collections; this group, however, is not typical of the order as most species are larger, winged and are found in out-door situations.

They are less common on eucalypts than on other broad-leaved evergreen trees and shrubs and although all types of vegetation and habitats should be sampled they are easiest to find in damp, forested areas. Especially rewarding for collections are the margins of rain forest, vegetation lining water-courses or other situations where there is a good growth of lichens and algae. They seem to favour areas of high atmospheric moisture. In the shade within rain forests they may be found on trunks but branches suitable for beating are often out of reach; they are common in some temperate rain forests. There are fewer species in dry inland areas but much collecting remains to be done there; they can be found in protected situations where moisture is retained, e.g. under bark or on logs and in the bases of grass tufts.

Psocids feed mainly on microflora such as algae, lichens, fungal hyphae and fungal spores; habitats suitable for such plant growth are also generally suitable for psocids.

Psocoptera are more abundant in species in tropical areas than elsewhere but they are not uncommon in the temperate regions where large populations are sometimes encountered.

Little detailed study has been made of their biology in Australia and there are undoubtedly many undescribed species.

Collecting

Apart from searching for individuals in the habitats listed above (and some species will only be taken by such search) by far the most rewarding method of collecting is by beating. Some collectors prefer a black cloth beating tray, rather than white; even an inverted umbrella can be used effectively. A stout stick should be used to beat the vegetation over the tray so that it is well jarred to dislodge the specimens. This is necessary as many species live under thin webbing which tends to prevent them from being affected by weak vibrations.

Psocids usually remain fairly still on the beating tray unless the weather is exceptionally warm and the tray is held for some time in direct sunlight. If the tray is gently tapped they will run and can be easily seen. For details on the construction and use of beating trays see Moulds, 1972, *Aust. ent. Mag.* 1(1): 7-10 (or A.E.P. Leaflet No. 2). They are best collected from the tray by means of an aspirator (pooter). A small camel-hair brush (or even a blade of grass or pointed twig), moistened with 70% ethyl alcohol, may be used to take them from the tray if an aspirator is not available. Although they will adhere quite readily to the moistened brush there is greater likelihood of their being squashed or otherwise damaged. As they are soft-bodied, especially their abdomens, they should always be handled gently. Occasionally specimens may be taken

in damp areas by sweeping vegetation with a sweep net. They are attracted to a yellow tray in small numbers and a few come to light, but these are nearly always males. Leaf litter samples can be extracted with a Berlese funnel.

Preservation

Specimens should be killed and preserved by transferring them directly from the aspirator (or brush) to 70% ethyl alcohol (ethanol). If they are killed in a killing jar or allowed to die before being placed in the alcohol they dry out very rapidly and become brittle with consequent loss of legs and antennae; they may even lose abdomen and head. The abdomen contracts on drying and it is difficult to study the genitalia (useful for identification in most genera) after the specimen has dried out. Also, such dry specimens tend to float in the alcohol.

If the diameter of the aspirator bottle is the same as that in which the alcohol is held the aspirator bottle can be removed from the apparatus and inverted over the alcohol. A gentle tapping will dislodge the specimens so that they fall straight into the preservative. Contents of the aspirator should be transferred to the preservative frequently to avoid death and drying out of specimens in the aspirator and to prevent excessive web spinning; this sometimes causes difficulties in transferring specimens. In the field the aspirator should be kept out of direct sunlight as much as possible.

Labelling

Specimens from each locality should be stored in a separate tube of alcohol and this should be appropriately labelled *in the field* with at least the place, date of collection and name of collector written in pencil on a piece of paper submerged in the alcohol with the specimens. It is desirable, but not always convenient, to keep specimens from different habitats in separate bottles, appropriately labelled. Little is at present known of habitat or host plant preferences in Australian species.

Storage

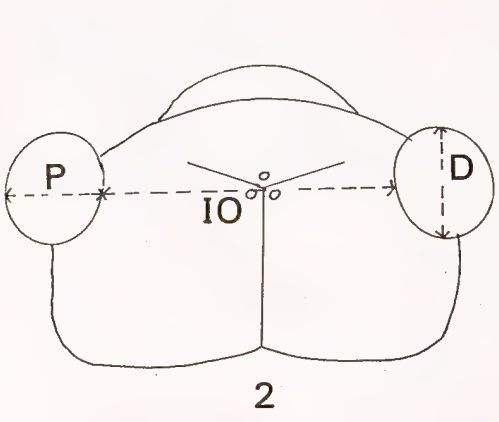
After returning from the field the catch can be sorted to species, each species from each locality being stored in a small vial which is labelled individually with full data. A small wad of cotton wool can be placed in each vial above the specimens so that they are held with minimum movement at the bottom of the vial. The data label is placed between the cotton wool wad and the stopper of the vial. This prevents movement of the labels damaging specimens. *Vials must be completely full of alcohol.* The vials can be stored in larger jars, and covered with 70% alcohol. It is advisable to use a large jar for each species, the jar being appropriately labelled *inside* with family and species name.

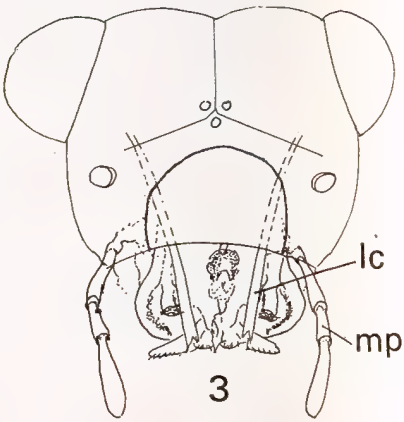
Dissection and microscope slide preparation

Although, with experience, common species can be readily identified, in many cases it is necessary to make dissections and microscope slide mounts of

at least the wings of one side, a hind leg, genitalia and sometimes mouth parts before positive identification is possible. Very small specimens may be mounted whole on the slide. Sometimes it is desirable to make a full dissection of a specimen.

Many procedures for making microscope slide preparations are described in books on microscopy and several of these are suitable for preparing mounts of Psocoptera. The following is a brief description of one of the procedures which I have found convenient and successful.





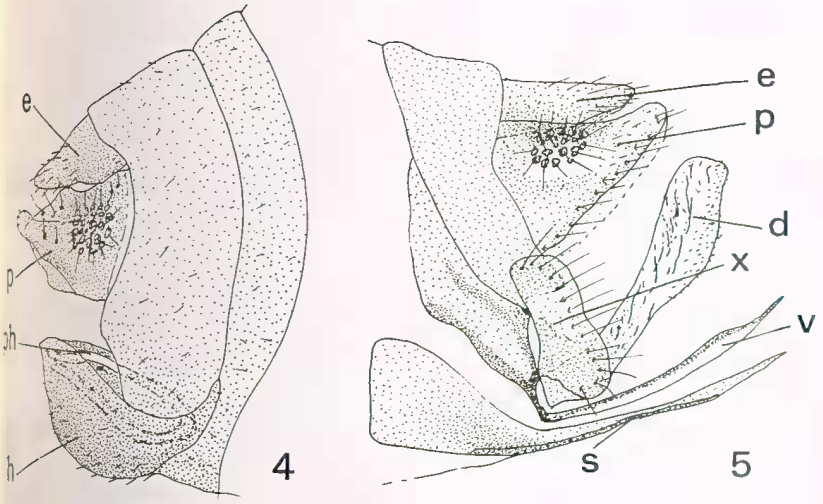
Figs 2, 3. (2) dorsal view of head showing measurements taken to calculate IO/D and PO (P/D) ratios; (3) anterior view of head after removal of labrum and mandibles. *lc,* lacinia; *mp,* maxillary palp.

The whole procedure is carried out using a binocular dissecting microscope giving a magnification up to about 32x. The dissections are carried out using "minutien" insect pins or their equivalent mounted in the ends of match-sticks. The blunt ends of these pins can be forced into the end of a match using a pair of pinning forceps. Before dissection, notes are made on the colour pattern of the specimen. The body length is measured as well as the distance between the eyes (IO), the transverse diameter of the eye (P) and the antero-posterior diameter of the eye (D), all from the dorsal side of the animal (Fig. 2). Two ratios are calculated from these measurements, IO/D and P/D (referred to in descriptions of species as PO).

The head and posterior part of the abdomen are placed in 10% potassium hydroxide until the soft internal parts are broken down. The process is speeded up if the "potash" is warmed slightly in a water bath and is then usually completed in about half an hour. The specimens are then placed in water to remove the potash. This and subsequent treatment can be carried out in a series of watch glasses or, preferably, the small, solid glass bowls sometimes known as

staining blocks". If the parts are very pale, they are placed in a stain (I use an aqueous solution of one gram of acid fuchsin per 100 c.c. water) until they are quite dark. They are then placed, for a minute or two, in each strength of 30%, 50% and 75% ethyl alcohol. The stained parts are now in the 75% block with the legs, thorax and wings. All are then placed in 96% ethyl alcohol to remove most of the water from the specimens after which they are transferred to "Euparal Essence" (butyl alcohol can be used if this is not available but is less satisfactory). Loss of stain occurs in the alcohols of lower concentration so if the specimens are too dark they can be allowed to stay in these until appropriately coloured. Only by experience can you learn how long this will take; specimens vary for no apparent reason. There is no colour loss once the specimens are in "Euparal Essence".

The wings are now removed from the thorax, using the dissecting needles to detach them at the base.



Figs 4, 5. (4) apex of male abdomen, right side: *e*, epiproct; *p*, paraproct; *ph*, phallosome; *h*, hypandrium; (5) apex of female abdomen, left side: *e*, epiproct; *p*, paraproct; *d*, *x*, *v*, gonapophyses (*d*, dorsal valve; *x*, external valve; *v*, ventral valve); *s*, subgenital plate.

A spot of "Euparal Mountant" (experience will indicate quantity, which varies according to thickness and size of specimen) is placed on a microscope slide and the head, thorax and legs transferred to it from the "Euparal Essence". The antennae, labrum and mandibles are removed from the head. If the head is mounted front uppermost the appropriate mouthparts will then be visible (refer Fig. 3). The legs are removed from the thorax and laid flat in the mountant. The wings are transferred to the mountant and suitably arranged dorsal side uppermost. The small black mass of faecal matter which is usually left in the end of the gut is removed. After this the abdomen is placed in the mountant

and dissected. This is done by cutting along the cylindrical abdomen to its apex and flattening it out to reveal the genital organs. If a female, the subgenital plate and gonapophyses together with the epiproct and paraprocts (apical structures of the abdomen) can be laid out flat (refer Fig. 5). If a male, the same can be done with the hypandrium, epiproct and paraprocts but the phallosome (the internal male organ), should be removed and mounted flat nearby on the slide (refer Fig. 4).

A fine glass coverslip can be placed over the mounted parts. With practice this can be done without disturbing the parts. If this proves to be unsuccessful it is better to leave the slide to dry somewhat (for about 24 hours) in a dust-free place. The coverslip can then be placed in position, with less risk of movements of the parts, after a little more mountant has been placed on its underside. Sometimes it is easier to use two small coverslips, one to cover the head, thorax and legs and the other to cover the wings and genitalia.

The slide should be labelled with a small, gummed, paper slide label, with full collection data and it should be stored in a *horizontal* position. Complete drying of the mountant will take some weeks but the slide can be examined under the microscope straight away if care is taken not to move the coverslip by touching it or tilting the slide for any length of time.

The procedure outlined above may appear to be tedious and complex but with a little practice and experience slides can be made quite rapidly and neatly. It is advisable to practise on a common species before attempting to prepare slides of other species.

Detailed examination of the slide will, of course, require a magnification higher than that needed for slide preparation.

Identification

Most general textbooks provide details of anatomy and keys to the families of Psocoptera; that in *The insects of Australia* refers to the Australian region only. Roesler (1944) published (in German) a key to the genera of the world (*Stettiner entomolgische Zeitung* 105: 117-166); although much out-of-date it is still useful but difficult to obtain. A list of world species is available (Smithers 1967, *Australian Zoologist* 14: 1-145) and a bibliography of literature to 1964 has been compiled (Smithers 1965, *Australian Zoologist* 13: 137-209).

For the identification of Australian species it is necessary to refer to the papers listed in *The insects of Australia* and the supplement to that work (1974).